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ABSTRACT

This module is designed to aid K-12 teachers to begin developing an awareness of the technological contributions of Black Americans to the United States' social and economic development during the 19th and 20th centuries. The module also demonstrates the ways in which selected teaching strategies may be developed to supplement regular classroom instruction. Information provided about each suggested activity includes the appropriate grade level, the educational objectives involved, the rationale for the activity, the structured sequence of learning activites leading to the larger educational objective, and a suggested culminating activity. Methods for student and activity assessment are also provided. (LH)

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SCIENCE HISTORY MODULE:
SCIENTIFIC & TECHNICAL CONTRIBUTIONS BY
AFRO-AMERICANS IN THE UNITED STATES

Developed by

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NATIONAL INSTITUTE OF EDUCATION

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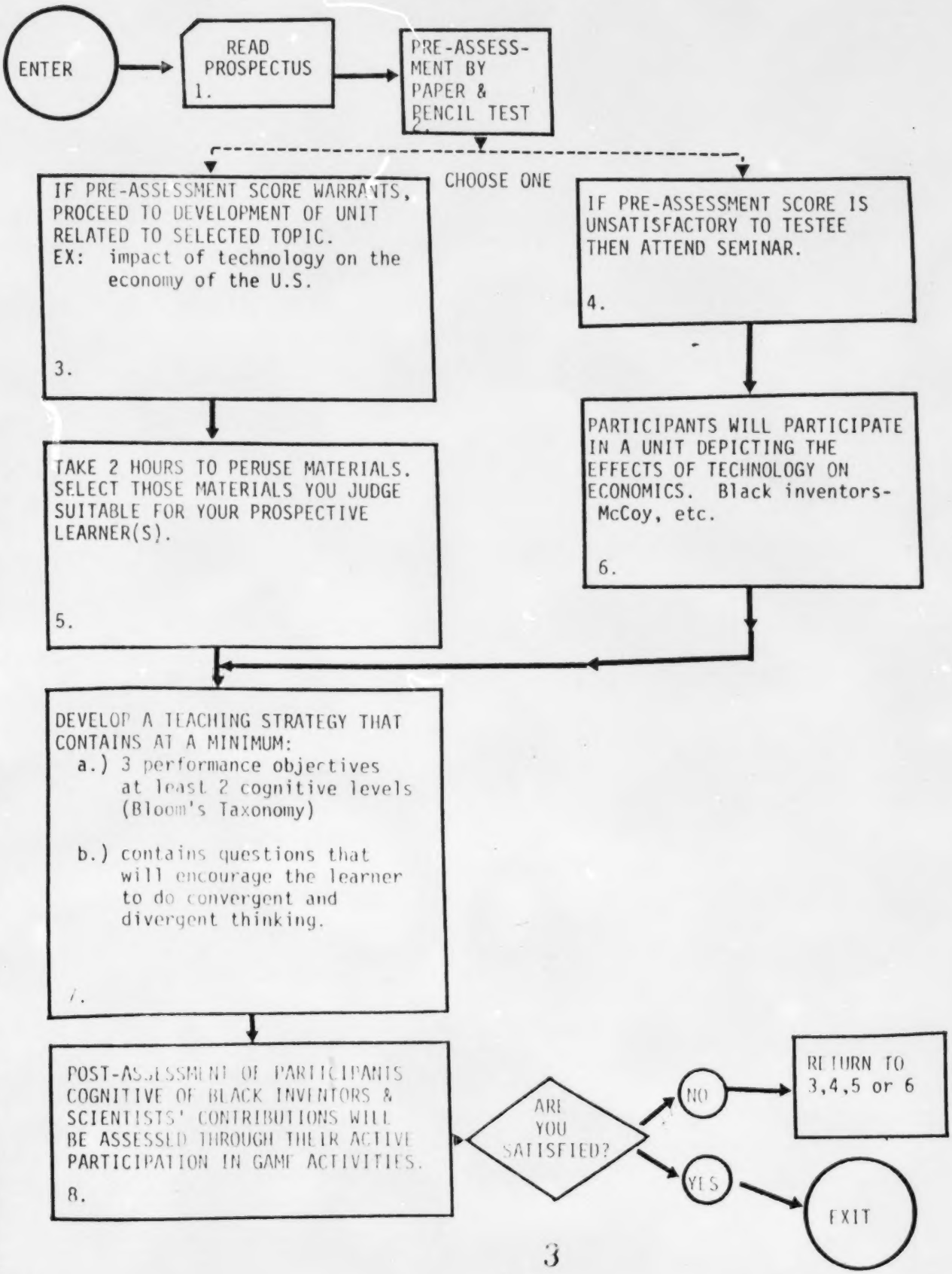
SP014968

SCIENCE HISTORY MODULE

CONTRIBUTIONS OF BLACK SCIENTISTS & INVENTORS DURING THE 19th & 20th CENTURIES


ENTER
READ PROSPECTUS
1.
PRE-ASSESS-MENT BY PAPER & PENCIL TEST
2.
CHOOSE ONE
IF PRE-ASSESSMENT SCORE WARRANTS, PROCEED TO DEVELOPMENT OF UNIT RELATED TO SELECTED TOPIC.
EX: impact of technology on the economy of the U.S.
3.
IF PRE-ASSESSMENT SCORE IS UNSATISFACTORY TO TESTEE THEN ATTEND SEMINAR.
4.
TAKE 2 HOURS TO PERUSE MATERIALS. SELECT THOSE MATERIALS YOU JUDGE SUITABLE FOR YOUR PROSPECTIVE LEARNER(S).
5.
PARTICIPANTS WILL PARTICIPATE IN A UNIT DEPICTING THE EFFECTS OF TECHNOLOGY ON ECONOMICS. Black inventors- McCoy, etc.
6.
DEVELOP A TEACHING STRATEGY THAT CONTAINS AT A MINIMUM:
a.) 3 performance objectives at least 2 cognitive levels (Bloom's Taxonomy)
b.) contains questions that will encourage the learner to do convergent and divergent thinking.
7.
POST-ASSESSMENT OF PARTICIPANTS COGNITIVE OF BLACK INVENTORS & SCIENTISTS' CONTRIBUTIONS WILL BE ASSESSED THROUGH THEIR ACTIVE PARTICIPATION IN GAME ACTIVITIES.
8.
ARE YOU SATISFIED?
NO
RETURN TO 3,4,5 or 6
YES
EXIT

PROSPECTUS: SCIENCE HISTORY MODULE

A paucity of the inclusion of minority ethnic group members' contributions to the U. S. economy in K-12 curricula has led to the creation of this module. Associated with this paucity of minority contributions has been the complaint of many teachers of an ignorance of the contributions of Afro-Americans to various facets of this country's economy.

The purpose of this module is twofold: (1) to enable K-12 teachers to begin developing an awareness and cognition of the technological contributions of Afro-Americans and the effects of these contributions upon the U. S. economy during the 19th and 20th centuries; (2) to demonstrate how teaching strategies that recognize these contributions may be developed and utilized as a viable supplement to bland curricula.

The following are prerequisites: (1) Knowledge of the basic economy of the United States during the 19th and 20th centuries; (2) Can write a performance or behavioral objective at a minimum of two cognitive levels (Bloom's Taxonomy of Educational Objectives); (3) Can write and/or develop convergent and divergent questions within a teaching strategy (Lesson Plan).

Terminal Performance Objectives

Given accessibility to resource materials and resource people, provided during the workshop, the participant will prepare a teaching strategy appropriate to his subject area or grade. The strategy must demonstrate its potential instructional effectiveness by identifying the Afro-American contribution and describing its effect upon the economy during the 19th and 20th centuries.

PRE-ASSESSMENT ON SCIENCE HISTORY UNIT

DIRECTIONS Complete the chart of Black pioneers of science and invention by (A) match the accomplishment to the man indicating the correct alphabetical letter in the space under the column titled accomplishments and (B) describe in your own words the effect this accomplishment had on scientific/economic progress during the 19th century in the United States.

BLACK PIONEERS OF SCIENCE & INVENTION	ACCOMPLISH-MENT(S)	ROLE OF ACCOMPLISHMENT IN THE DEVELOPMENT OF SCIENTIFIC/ECONOMICAL PROGRESS
1. Garrett A. Morgan		
2. Benjamin Banneker		
3. Norbert Rillieux		
4. Lewis H. Latimer		

BLACK PIONEERS SCIENCE & INVENTION	ACCOMPLISH-MENT(S)	ROLE OF ACCOMPLISHMENT IN THE DEVELOPMENT OF SCIENTIFIC/ ECONOMICAL PROGRESS
5. Percy L. Julian		
6. Daniel Hale Williams		
7. Granville T. Woods		
8. Elijah McCoy		
9. Jan Matzelinger		

ACCOMPLISHMENT(S)

a. invented an automatic lubricator

b. invented railway-telegraphy, telephone transmitter, and coined a word

c. invented the vacuum-pan evaporator

d. invented the gas mask and traffic lights

e. perfected techniques of preserving plasma and made blood banks possible

f. mathematician, surveyor, astronomer - reproduced L'Enfant's plans to complete work of laying out the city of Washington, D.C.

g. pioneer in electrical lighting

h. invented a lasting machine that could turn out a complete shoe

i. developed synthetic cortison and other important therapeutic drugs

j. performed the first open heart surgery

k. revolutionized southern agriculture and extracted 75 different products from the pecan

CANDY = SUGAR + A BLACK MAN'S GENIUS*

Grade Level:

This lesson is designed to be taught with upper elementary level students. The time for teaching this unit may vary, but it is anticipated that the activities could be accomplished within 4-8 days. A multi-dimensional curriculum approach is utilized throughout the lessons. The activities are designed to be used in various instructional settings, namely: large groups, peer groups, and individuals. The teacher functions as the facilitator of learning.

Performance Objectives:

1. The student will be able to describe in writing this scientist's experiences, invention and use.
2. Given an activity, the student will demonstrate the recognition of the problems associated with the sugar processing industry during the middle of the 19th century by oral discussion.
3. Upon completion of the activities described in this module, the student will be able to organize this information and experiences for the purpose of a presentation. (This presentation may take different forms such as a mural, book, oral report, role playing situation, diarama, etc.)

*Slide-tape showing an elementary class involvement in several of the activities described in this lesson.

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Rationale:

The invention of the vacuum pan evaporator system revolutionized the sugar processing industry. Norbert Rillieux's contribution had several effects upon the economy of the 19th century. This lesson plan provides activities to enable the student to formulate a conceptual framework which will explain the effect of this invention on the economy of the 19th as well as that of the 20th century.

Initiating Activities:

The instructional setting for the first activity is the large group. The second activity is accomplished by using small peer groups.

I. Initiating Activities

A. Have an arrangement of many different (sizes) pieces of candies/candy bars visible in the classroom. Try to include candy/candy bars from different countries such as Mexico, Holland, England, etc. Questions: (1) Why do you think the price of candy/candy bars is only 1¢, 5¢, 10¢ or 15¢? (2) What ingredient(s) does this collection of candy/candy bars have in common? (3) Do you think we (all together) would have enough money today in our pockets or purses to purchase this amount of candy from a store? Permit students to compute cost of candies/candy bars and the amount of money the students could pool to finance the purchase of the candies/candy bars. The purpose is to give the students a realistic experience in determining the inexpensiveness of the candies/candy bars.

B. Divide class into small groups of students (maximum in a group not to exceed 5). Each group receives small pieces of sugar cane and

sugar beet. The students should identify (name) the small pieces before proceedings. The teacher will state the problem for the students--What relationship exists between these two plants that are sources of sugar? Relationship is defined here to mean the similarities and differences that exist between sugar cane and sugar beets. Encourage the students to explore on their own while making written notes on their observations. The teacher may wish to provide each group with a knife, matches, candle, candle holder, container of water, and spoon. The teacher will urge the students to make use of their five senses as they explore. The teacher may wish the students to use a chart for recording of their observations.

	Sugar Cane	Sugar Beets
Taste	sweet	
Smell		
Feels like		
Water		
Heat		

Permit each group to report on their findings. It may be necessary to limit each group to one observation in order for each group to report a finding not previously stated.

Second Activities

Instructional Setting:

Children should be divided into small groups (not more than five). These may be the same groups as used during the first day's activities.

Materials:

Sugar cane, sugar beet, refined white sugar, brown sugar, hot-plate, wooden stirring spoon, metal pot, water, candle, matches, candle holder, spoon.

Lesson:

1. Teacher asks students what they discovered about the sugar beet and sugar cane on the previous day (allow about 3-5 minutes for a quick review).
2. Ask the students to look at the packets on their tables (packets contain brown and white sugar). Question the students as to how they think the sugar present in the sugar cane and sugar beet is processed in order to obtain granulated sugar--review the most important use of sugar (particularly to children--candy). The teacher may also have available packets of sugar from Mexico. This could be used to show the contrast between sugar refined in the United States and Mexico.
3. Let the children confer with their group about the process of making sugar. Each group may determine a process.
4. One person from each group reports upon the process his group has decided. Hopefully, some group will mention cooking the juice from the sugar cane and the sugar beet. If none of the groups arrive at this conclusion, the teacher may then start to ask questions that will lead the students to this conclusion. Be prepared at any point hereafter to have students ask to "look it up" in the reference books.

5. After the group has agreed that cooking the juices from the sugar cane and sugar beet might be a possible process, the teacher might ask what would be boiled away in the cooking process so that only the sugar would remain. Hopefully, because the students have handled the sugar cane and the sugar beet and felt the sticky watery substance of both, they will arive at water as being the substance that is cooked away. If the students do not arrive at this conclusion independently, the teacher may ask questions that will lead them to this hypothesis.

6. Once they have concluded that the substance cooked away is water the teacher may ask the students if they feel that adding water to the granulated sugar at their desks would produce a watery, sticky, liquid similar to that present in the sugar cane and the sugar beet. The students may test this in small groups by placing a small amount of water in a petrie dish and mixing in a small amount of sugar. Each student in the group should have the opportunity to feel the substance once it has been thoroughly mixed with water. (Small wet towels should be provided at each table so that the members of the group can wipe the sticky from their fingers.)

7. The teacher may ask the children if they think it would be possible to reverse the process. Do they think that by cooking the watery, sticky substance they would be able to boil away the water and have granulated sugar again?

8. Hopefully, the students may come up with this conclusion and want to test the hypothesis.

9. Students would then form groups of five and test their hypothesis.
10. Ask students to determine what happens when heat is applied to sugar. Let the students perform this by using the candle, spoon, and sugar. Encourage oral observations.

Third Activity

1. Distribute copies of booklet "From Sugar Cane to Sugar Bowl" to students. This booklet may be obtained from Imperial Sugar Company, P. O. Box 9, Sugar Land, Texas 77478. Colorful pictures illustrate the process of refining sugar. The teacher can aid in the explanation of the process.
2. By means of story telling the teacher will introduce Norbert Rillieux. Visuals should be used to illustrate his experiences as well as the sugar industry as it existed in the middle 19th century. Please refer to pages 13-23, Black Pioneers of Science and Invention.
3. At this point the effect of Rillieux's invention upon the economy can be brought into focus. Relate it to today by referring back to the price of candy.

Fourth Activities

Instructional Setting:

The students should be divided into groups of not more than five. This is done in order to provide the student with a good view of the process and give him/her a feeling of active involvement in the experiment even when it may not be his/her turn to stir the mixture.

Supplies:

Hot plates, metal pots (should be deep, stirring sometimes can result in a splashing of the boiling sugar), wooden spoons for stirring, hot pot holders for holding the handle of the pot, ingredients for candy (listed under #6).

1. The teacher should ask the students to discuss what they have experienced thus far about the source of sugar and the process by which we have granulated sugar.
2. Hopefully the children will recall the watery, sticky mixture of sugar and water. They will be eager to try the experiment themselves. An inquiry should be made as to which of the students has made candy at home. The students will probably be able to list the ingredients needed to make candy.
3. After the children with the teacher's guidance have arrived at the general process for making the candy, the roles of the students in each group should be listed.
4. The groups should be allowed time prior to beginning the experiment--no group should be allowed to begin until their appointed secretary has made a written list of the jobs needed to perform and record the experiment.

Roles in the Experiment:

A. Secretary--list the roles of the other members of the group, record the events during the experiment, be responsible for the writing up of the group's observations and conclusions. She/he is to do this only after group consultation.

B. Materials person--responsible for seeing that the group has on the table all the materials necessary to perform the experiment. All materials must be at the group's table before the experiment

begins--hot pots of boiling sugar and roaming bodies are not a good mixture.

C. Preparations Person--to prepare the experiment, mix sugar and water, and turn on the hot plate.

D. Chief stirrer--person responsible for the initial stirring and responsible for asking the different members of the group to take turns at stirring.

E. Candy person--When the group agrees that the candy is finally ready to be put on the wax paper it is the responsibility of the candy person to spoon the candy mixture onto the waxed paper. This person will also determine when the candy is cool enough to be eaten.

5. The groups are to report their experiences. The teacher can guide the discussion; but encourage students to have a written group report which tells the procedure they followed as well as any observations they made.

6. Two recipes are submitted.

First recipe

A. To start you will need

2 cups of sugar

1/8 teaspoon cream of tartar

a few drops of food coloring

2/3 cup of water

B. To cook the candy you will need

a small pot

a cooking spoon

a small bowl of cold water

C. Put all the ingredients into the pot. Stir until they are mixed together.

D. Now put the pot on the stove (hot plate). You will have to wait until the mixture boils. You will know that it is boiling when you see lots of bubbles moving along the top of the mixture. But this means it is very hot. So be very careful.

E. After it has been boiling for about 3 minutes it is ready to test. Dip your spoon into the mixture (remember it is very hot) and let the spoon drip off into the bowl of cold water. If the mixture turns hard in the cold water you can turn off the heat. If it does not turn hard, let it cook one more minute and try again.

F. You will need one more thing now to finish your candy. Take a flat pan like a cookie sheet, and rub margarine all over the inside. This will make the pan slippery so the candy can be taken out of it easily. Pour the candy from the pot into the pan.

G. You will have to wait about an hour now for the candy to get cool and turn hard. Then take it out of the pan, break it up and happy eating.

Second Recipe

A. To start you will need:

1 cup of white sugar

1 cup of brown sugar

½ cup of water

1 tablespoon of margarine

¼ teaspoon cream of tartar

B. Directions: Put all the ingredients into the pot. Stir until they are mixed together. Now place the pot on the stove and turn on

the heat. Continually stir the mixture. The mixture will begin to boil. You will know that it is boiling when you see lots of bubbles moving along the top of the mixture. But this means it is very hot, so be very careful. After it has been boiling for about three minutes it is ready to test. Dip your spoon into the mixture (remember it is very hot) and let the spoon drip off into the bowl of cold water. If the mixture turns hard and forms a ball you can turn off the heat. If it does not turn hard, let it cook one more minute and try again. After you have tested the candy and are sure it will turn hard in cold water, turn off the heat. You will need a sheet of waxed paper, placed on a flat surface. Spoon the candy from the pot--be very careful the mixture will be very hot. Allow the candy to cool until it is hard. When the candy is cool enough it can easily be removed from the waxed paper.

Fifth Activity

These two activities require the teacher to assume the role of demonstrator and are to be used in a large group instructional setting. The teacher may use one of these activities or elect to use both of them. The purpose of these activities at this point is to provide the student with a conception of vapor pressure.

1. Show film loop #16: "Drinking Boiling Coffer." This film loop is taken from the Inquiry Development Program in Physical Science, Science Research Associates, Inc., Chicago. The following information is reproduced from the teacher's guide written by J. Richard Suchman.

Problem 41

Film 16: "Drinking Boiling Coffee"

Synopsis: The demonstrator pours coffee from a pitcher into a glass and drinks a small amount of the coffee from the glass. He then puts the glass on a metal plate and covers it with a large glass jar. The demonstrator puts on a pair of asbestos gloves as the camera moves in to a close-up of the glass of coffee inside the large jar. After a few minutes the coffee burst into a vigorous boil. It dies down for a moment, then continues to boil vigorously. After a few more minutes the coffee stops boiling and vapor begins to form on the inside of the large jar. He picks up the glass of coffee, using the asbestos gloves, and drinks from the glass.

Questions:

Why does the coffee boil? Why does the coffee stop boiling?

Why is the coffee cool enough to drink before and after boiling?

Why does the jar steam up after the coffee stops boiling?

Why does the coffee boil suddenly, settle for a moment, then boil steadily?

Conditions: The coffee is hot but drinkable--about the usual temperature of hot coffee. The large jar and metal plate form an airtight chamber, which is connected to a vacuum pump through a hole in the center of the metal plate. After the coffee is placed inside the jar, the air is pumped out of the chamber. When the coffee stops boiling and the jar clouds up, air is again being admitted to the chamber at atmospheric pressure.

Principles: Pressure. Atmospheric pressure. Changes of state. Boiling. Gases.

Analysis: Boiling occurs when the vapor pressure of the liquid is equal to the atmospheric pressure above the liquid. Boiling is usually caused by heating the liquid until its vapor pressure equals atmospheric pressure. In this case boiling is caused by lowering the atmospheric pressure above the liquid until it equals the vapor pressure. The temperature of the coffee is essentially unchanged.

The first burst of bubbles from the coffee is probably due not to actual boiling, but to the release of atmospheric gases absorbed in the liquid. After a moment these gases are largely released and actual rapid vaporization, or boiling, of the coffee begins.

When the air is again admitted to the jar through the small hole in the metal plate, atmospheric pressure increases and boiling ceases. As the air comes into the large evacuated jar through this tiny opening, it expands to fill the jar. This expansion causes a decrease in the temperature of the air. The air inside the jar becomes sufficiently cold to condense the water vapor from the coffee on the inside of the jar, forming a mist of droplets on the jar surface.

The demonstrator removes the jar and drinks some of the coffee to show that the coffee is still cool enough to drink. The asbestos gloves are unnecessary and are used merely to add to the students' expectation that the coffee will be hotter after boiling.

2. Demonstration: The collapsing can

Synopsis: About one inch of water is put into a varnish can or other large tin can having a screw top, and the can is placed above

a Bunsen burner flame or on a stove. When the water begins to boil and steam is escaping from the mouth of the can, the lid is then placed over the can. The can is removed from the flame. It crumples and collapses.

Questions:

Why does the can collapse?

Why was it necessary to put water in the can?

Why was the can heated?

Conditions: The can must be sealed tight. A cork or stopper can be used instead of a screw top. Asbestos gloves should be used to avoid burns from the steam or hot can. The can will crumple more slowly if allowed to cool in air without a stream of cold water being poured over it. The can would not crumple in a vacuum.

Principles: Newton's first law of motion. Displacement. Atmospheric pressure. Conduction of heat. Vapor pressure. Gases. Changes of state.

Analysis: For the walls of the can to move inward, it is necessary that the forces pushing in be greater than the forces pushing out. The atmospheric pressure pushing in on the can remains constant throughout the experiment; therefore the forces pushing outward must have decreased. There must have been a sudden reduction of pressure inside the can when the cold water was poured over it, to cause the sudden crumpling of the can.

When the can is heated, the water inside begins to boil, producing large amounts of water vapor. The water vapor pushing upward from the bottom of the can forces much of the air in the can out of the mouth. When the can is sealed, the water vapor

inside continues to exert pressure on the inside of the can. When the cold water is poured over the can, heat is rapidly conducted from the inside of the can to the stream of water, causing a sudden cooling of the vapor inside the can.

When the vapor is cooled, it condenses to a liquid occupying a much smaller volume (about 1/1000 of the volume it occupied as vapor). The outside air cannot enter the can to fill the volume. There is a reduction in pressure inside the can, and the little air left inside expands to fill the can. The atmospheric pressure outside the can then pushes the walls inward.

If the can had been allowed to cool in the air without the stream of cold water, the heat from inside the can would have been conducted away more slowly (the heat conductivity of air is not as great as that of water) and the water vapor inside would have condensed more slowly. Moreover, if there were any tiny leaks in the can, the air from outside would have been able to leak in slowly, keeping the pressure inside equal to that outside. By cooling the can very quickly, we cause the pressure inside to drop very quickly, so that any small air leaks do not have time to equalize the inside and outside pressures.

Culminating Activity:

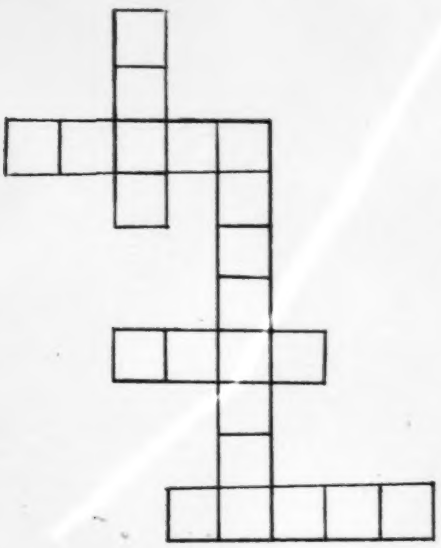
1. Refer to performance objective #3. Upon completion of the activities described in this module, the student will be able to organize this information and experiences for the purpose of a presentation. (This presentation may take different form such as a mural, book, oral report, role playing situation, diarama, etc.)

2. The students are to design their own activity in which they will present the information they have assimilated from the experience presented in this lesson plan. The teacher should offer some suggestions, but strongly encourage the students to develop their own creative modes of presentation. This activity is viewed as a sharing session. Students should be permitted to formulate their own instructional setting while working on their presentation. The teacher will function as a resource person.

CANDY = SUGAR + A BLACK MAN'S GENIUS

Puzzles

PUZZLE 1



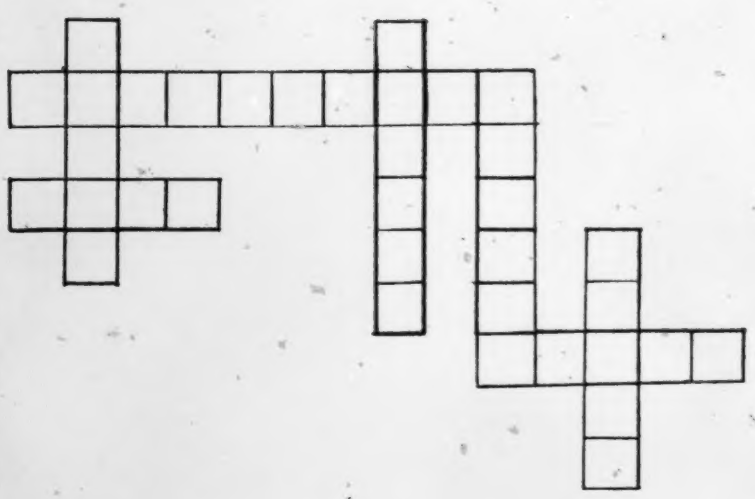
Puzzle Clues (1)

down

1. bubble up and give off steam
2. man who plans and builds machines

across

1. color of refined sugar
2. a source of sugar
3. the color of unrefined sugar



Puzzle clues (2)

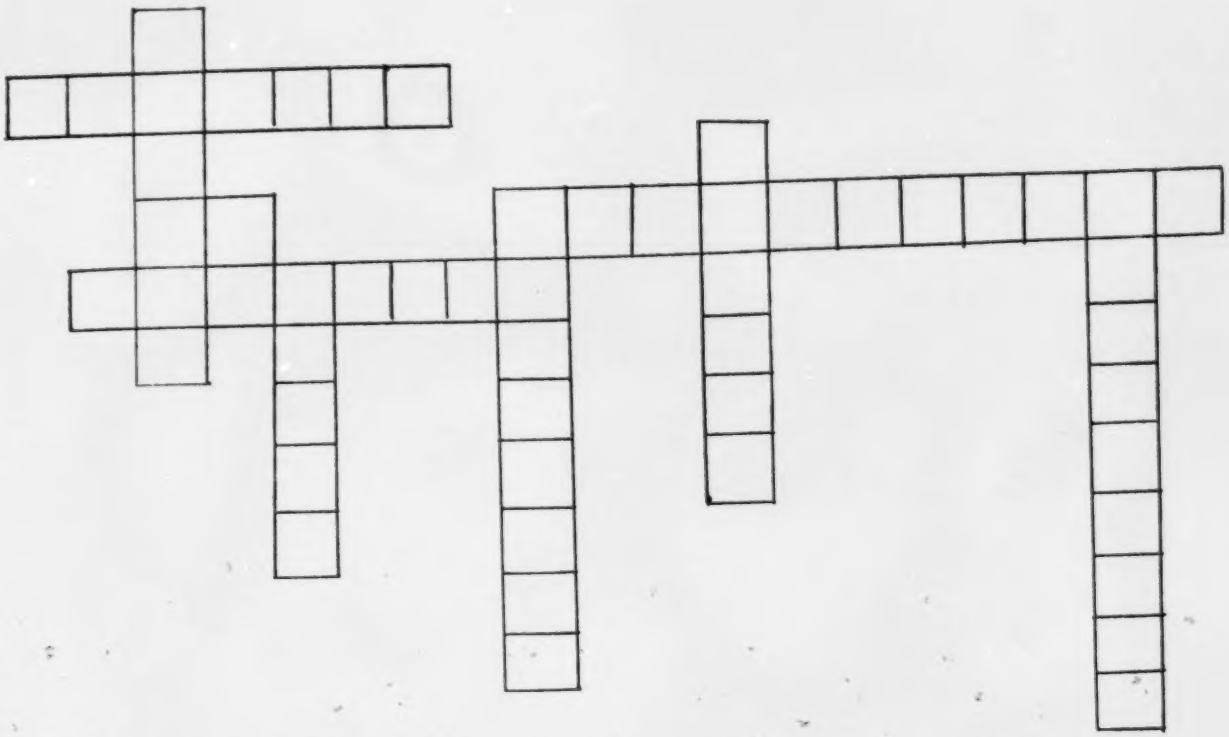
down

1. a major source of sugar
2. _____ pan, invention of Rillieux
3. people who stir the syrup-like mixture
4. city where Rillieux is buried

across

1. birthplace of Rillieux
2. mix by moving around with a spoon
3. sweet thick liquid

PUZZLE 3



Puzzle Clues

down

1. to make pure
2. large pot for boiling liquid
3. regular shaped pieces with angles and flat surfaces into which many substances solidify
4. government grant to a person by which he is the only one allowed to make or sell a new invention
5. high priced

across

1. man not a slave
2. one who invents
3. sugar that has been burned

RESOURCE MATERIALS

"Candy = Sugar + A Black Man's Genius"

1. Sugar. Holly Sugar Corp. Director of Public Relations. Colorado Springs, Colorado 80901. Free. Titles include:

   "A Beet Sugar Teaching Kit." 1969. History of the beet sugar industry in the United States, with question and answer booklets for 30 students.

   "The Energy Primer." Undated. 10 pp. Story of sugar for elementary age children.

   "The Holly Sugar Story." Undated. Leaflet. Pictorial chart describing how sugar is extracted from sugarbeets.

2. United States Beet Sugar Association, Box 500, Dansville, N.Y. 14437. Teacher's kit on beet sugar includes four wall charts: "The Sugar Beet--Nature's Most Efficient Plant," "Growing Sugar Beets," "Extracting Beet Sugar," and "Beet Sugar--Aids in Sensible Diets"; "A Teaching Guide for the Beet Sugar Unit"; "A Beet Sugar Manual"; classroom quantities of "Bill Gets a Scoop" and "Question-and-Answer Leaflets" on beet sugar. Materials also useful for home economics and nutrition. (3rd-9th grades)

3. National Confectioners Association, 36 S. Wabash Ave., Chicago, Ill. 60603. Facts, history, and uses of candy and chocolate. Booklets: "Candy Goes to School," "The Story of Candy," "How to Protect Dental Health While Enjoying Candy," "How To Lose Weight and Stay Happy by Eating Candy," "How to Drive Safely and Fight Fatigue by Eating Candy," "How To Relieve Tension With A Candy Break," "How To Get Quick Energy and Keep Alert by Eating Candy," and others. Materials also useful for health education. Single copies only. (7th-12 Grades)

4. California and Hawaiian Sugar Company, Public Relations Dept., One California St., San Francisco, Ca. 94106. Hawaii and the sugar industry. Map: "Hawaii" and poster: "Hawaiian School Children"; single copies to teachers (3rd Grade-College). Booklets: "Cane Sugar and Hawaii," on Hawaiian sugar; and "Growing Cane Sugar Crystals on a Small Scale," for science classes. Produces 16 mm. color, sound film: "Hawaii--the Sugar State," distributed by Modern Talking Picture Service; see branch office addresses. Materials, including film available only to schools in Illinois, Wisconsin, and those west of the Mississippi, but excluding Louisiana, Arkansas, and south Texas.

NOW YOU CAN GIVE*

Grade Level:

These lessons are designed to be taught with upper elementary, junior high, and high school students. The time for teaching this unit will vary with the age/grade level of the students. It is anticipated that these activities could be accomplished within

(a) 8-11 time periods for upper elementary students,

(b) 4-8 time periods for junior high students, and

(c) 3-5 time periods for senior high school students.

The time period depends upon the approach used by the teacher. If presented as a science unit the time will be shorter in contrast to the presentation of the unit within a multi-dimensional curriculum approach. The activities are designed to be used in various instructional settings and the activities include a multi-media base as well as utilization of community resources. The teacher functions as the facilitator of learning.

Performance Objectives:

1. The student will be able to describe Charles Drew's contribution, its effect upon the life of man, and his technique of preserving plasma. The student will exercise his option in the method to describe the above.
2. Given access to materials that can be utilized to construct a model of a transfusion apparatus, the student will construct the model and demonstrate the mechanics involved in a blood transfusion.

*Slide-tape and video tape showing a class involved in several of the activities described in this lesson. The slide-tape also demonstrates the use of community resources for developing effective teaching strategies.

3. The student will be able to state orally or in writing the social problems encountered by Dr. Drew as he perfected the techniques of preserving plasma and established blood banks.
4. Given access to a diagram of the heart, and a heart model, the student will be able to label the four chambers of the heart and trace the flow of blood through the heart. Minimum acceptable performance will be the correct labelling of three of the heart chambers and correctly tracing the flow of blood through the heart.
5. Given access to a microscope, slides of blood cells, descriptive materials of blood, the student will be able to identify and describe blood cells in writing accompanied with diagrams of the cells.

Rationale:

In the 1930's a great medical discovery was made. Blood could be drawn from a donor and preserved for a period of twenty-one days. Though many people were responsible for this medical discovery, the brilliant research of one man in particular, Dr. Charles R. Drew, made the preservation of drawn blood possible. As Director of the first American Red Cross blood bank he overcame many technical problems which saved many thousands of lives during World War II. These lessons/activities have been designed to enable the student to formulate a conceptual framework which will explain the magnitude of this scientist's accomplishments.

Initiating Activities:

The instructional setting can vary; but three small groups can work simultaneously together on the three activities. Another variation is to utilize the large group setting for all of the activities.

A. Group I

Materials: tape recorder, listening post and audio tape on Dr. Charles Drew (Black Heritage series by Imperial International Learning, 1969), strips of tag board, magic markers.

Lesson:

1. Students are instructed to listen to audio tape describing the life of Dr. Drew.
2. After listening to the tape, each student is to write three words that can be used to tell the story of Dr. Drew and his accomplishment. Word strips are to be used for bulletin board.
3. Teacher asks students to orally describe
   (a) Drew's accomplishments
   (b) social problems encountered by him
   (c) his childhood experiences

B. Group II

Materials: Film entitled "Circulation of The Blood" from American Heart Association

Lesson:

1. Students are to view film for purpose of obtaining a pictorial representation of the circulatory system and the blood cells' movement through the capillaries.
2. Students are to formulate two questions they can answer about the circulatory system. These questions are to be used later in a sharing session with the large group.

C. Group III

Instructional Setting: Children may be arranged in a semi-circle to facilitate their seeing of models and posters.

Materials: Heart models, wall posters of heart and circulatory system, individual heart diagrams, and About Your Heart and Your Bloodstream (pamphlet, American Heart Association and Red Cross).

Lesson:

1. Teacher asks students to read pages two and three of booklet. (allow 3-5 minutes) The instructor may begin the activity by asking the following questions:

   (a) How are cells able to receive food and get rid of wastes?

   (b) What provides the force for moving the blood through the body?

   (c) How would you describe the heart?

After the students have described and discussed the heart, then proceed to using the heart models and diagrams for tracing the blood flow through the heart. Allow the students to observe the heart chambers, valves, and major vessels and orally describe these to you. The students will freely provide observations about what they see. Utilize questions to focus their attention on certain parts of the heart, ex.: How do you think the blood gets from one chamber to another? How are the chambers different? What do you think the function of those strings (fibers attached to valves) is? Following the observation of the heart and an oral description of blood flowing through the heart, each child was given a heart diagram and asked to trace the flow of blood and label the parts of the heart.

Developmental Activities:

Group I

1. Our group of students can construct the transfusion apparatus. Materials - Two empy plastic hand-lotion or liquid soap containers, twelve to eighteen inch piece of plastic tubing, electricians tape, large paper clip, scissors. Directions - Cut the top from a plastic bottle. Insert a piece of plastic tubing into the top. Wrap electrician's tape around the top and the tube. Run the tube into another empty plastic container. Pour water into a small opening in the former container. Use a paper clip to show how the flow of liquid is controlled.

2. Students may wish to work in pairs. Each team will explain the process to a member of another group of students.

Group II

The students may work in groups of twos. For each group a microscope should be set up with a blood smear slide (use oil immersion). At each microscope should be The Story of Blood (American Red Cross) pamphlet. (The student should be given specific instructions on how to use the microscope. With certain microscopes you may not want them to do the focusing.) Each student should be allowed to construct diagrams of the blood cells and describe them in writing or orally. The student may be asked the following questions: Do all blood cells look alike? Why are some cells different? Describe the shapes of the red and white blood cells. Following these questions, the students may be required to discuss their descriptions of blood cells.

Group I and group II combine to view the film, Blood Is Life Pass It On. This film is available from the American National Red Cross. This film will motivate the students to inquire about their values and opinions regarding the giving of blood. The teacher can serve as a discussion leader.

Culminating Activities:

1. Divide the class into small groups and have each group plan a short dramatic skit portraying one of the following parts of Dr. Drew's life:
   (a) early years
   (b) success at Amherst
   (c) applying for medical school
   (d) laboratory work on blood plasma
   (e) the Red Cross project and controversy
   (f) return to Howard University
   (g) receiving the Spingarn Medal
   (h) the fatal accident
2. A committee of students can write a letter of resignation from Dr. Drew to the Red Cross. His personal reasons for resigning and his feeling about the Army directive should both be included in the letter.
3. Three other Black doctors have made significant contributions to the world of medicine: Dr. Daniel Hale Williams, a pioneer in open-hear surgery; Dr. Leonidas H. Berry, the developer of a gastro-biopsy instrument; and Dr. Samuel L. Kountz, one of the first to work with kidney transplants. Students may obtain information about each of these doctors and report their findings to the class in a sharing session.

4. Newspaper articles can be collected that relate to the use of blood, storage of blood, need for blood, etc. This can be used for a scrapbook or as part of the bulletin board display.

5. Sites for field trips could include

   (1) community Blood Bank

   (2) American National Red Cross

   (3) American Heart Association

   (4) Blood Bank Mobile Unit

   (5) Blood Bank of a large hospital

NOW YOU CAN GIVE

Resource Materials

American Heart Association, 44 East 23rd Street, New York, New York, 10010. Local: Consult your local branch office.

American National Red Cross, Midwestern Area, 4050 Lindell Blvd., St. Louis, Missouri, 63108.

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NOW YOU CAN GIVE

Puzzle 1

DOWN:
A Storage place
A person who gives

ACROSS:
A life giving liquid

Puzzle 2

ACROSS:
To keep safe or protect from spoiling
To hand over as a present without pay
Sudden disturbance

DOWN:
Another name for someone who operates

Puzzle 3

ACROSS:
Poisonous
Half solid mass
To keep cool

DOWN:
To bring together
A unit of measure

Puzzle 4

DOWN:
A place you go when you are very sick
A sport
A substance very dangerous to life and health

ACROSS:
A place you go to be educated
Blood without the corpuscles

Puzzle 5

DOWN:
Place where goods are kept
Kind, class or group having common characteristics
A minority person

ACROSS:
Opposite of negative
Causing to pass from one container or holder to another
Person who has skill or who knows much about some special thing

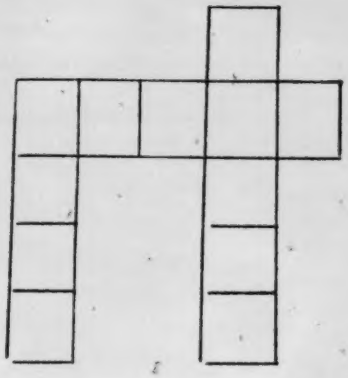
DOWN:
Person who knows how to treat diseases
One who teaches
The part of the body that pumps the blood

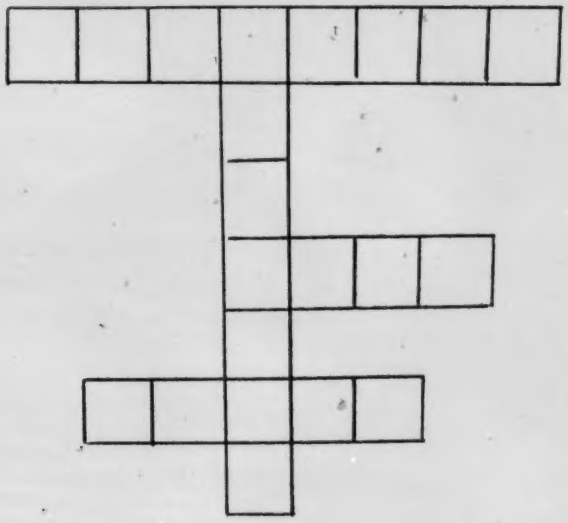
Puzzle 7

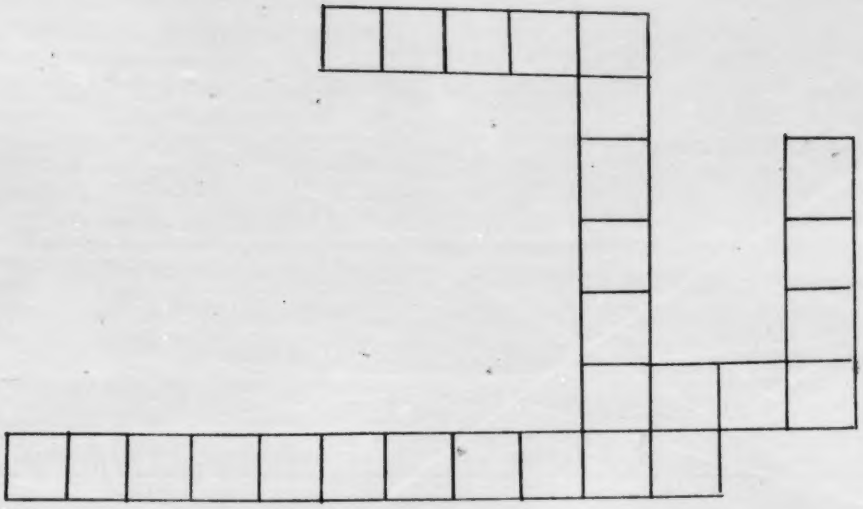
ACROSS:
Change from a liquid to a thickened mass
Men who fight in wars
A battle
The earth
Not positive

DOWN:
Science that deals with the characteristics of elements
Great natural ability
A substance very dangerous to life and health
Having life
Having all its parts

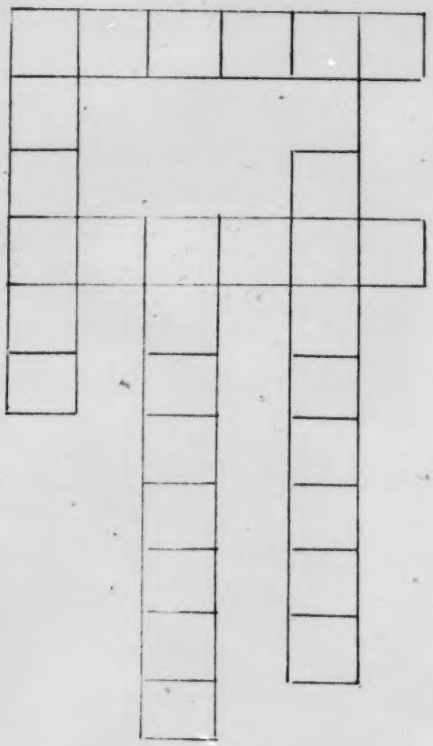
NOW YOU CAN GIVE

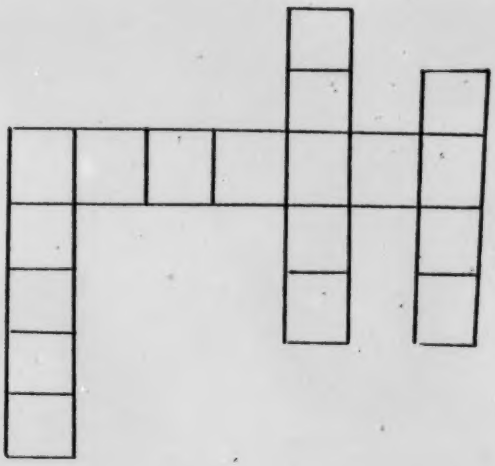


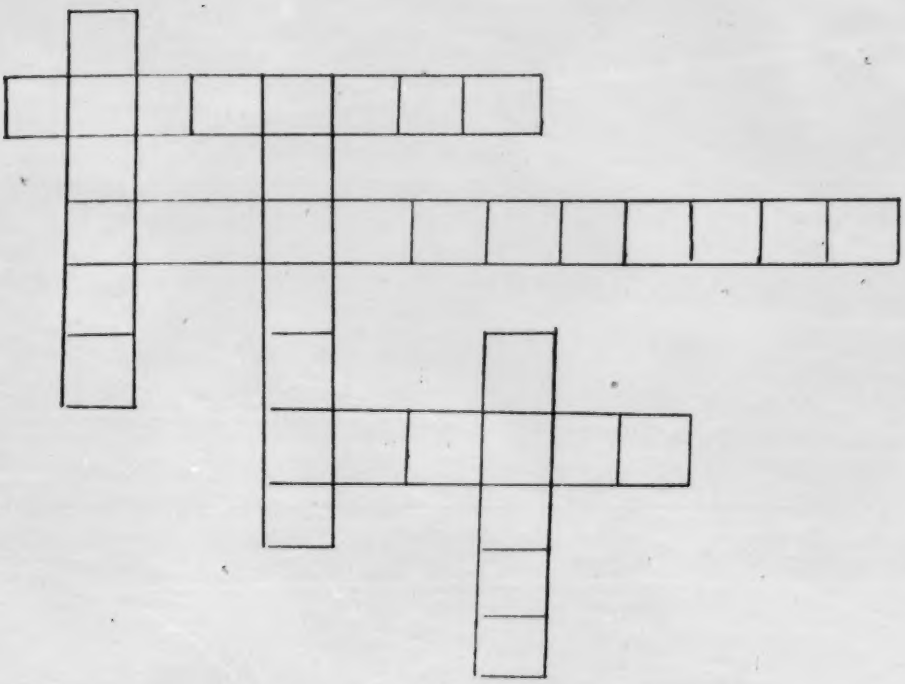




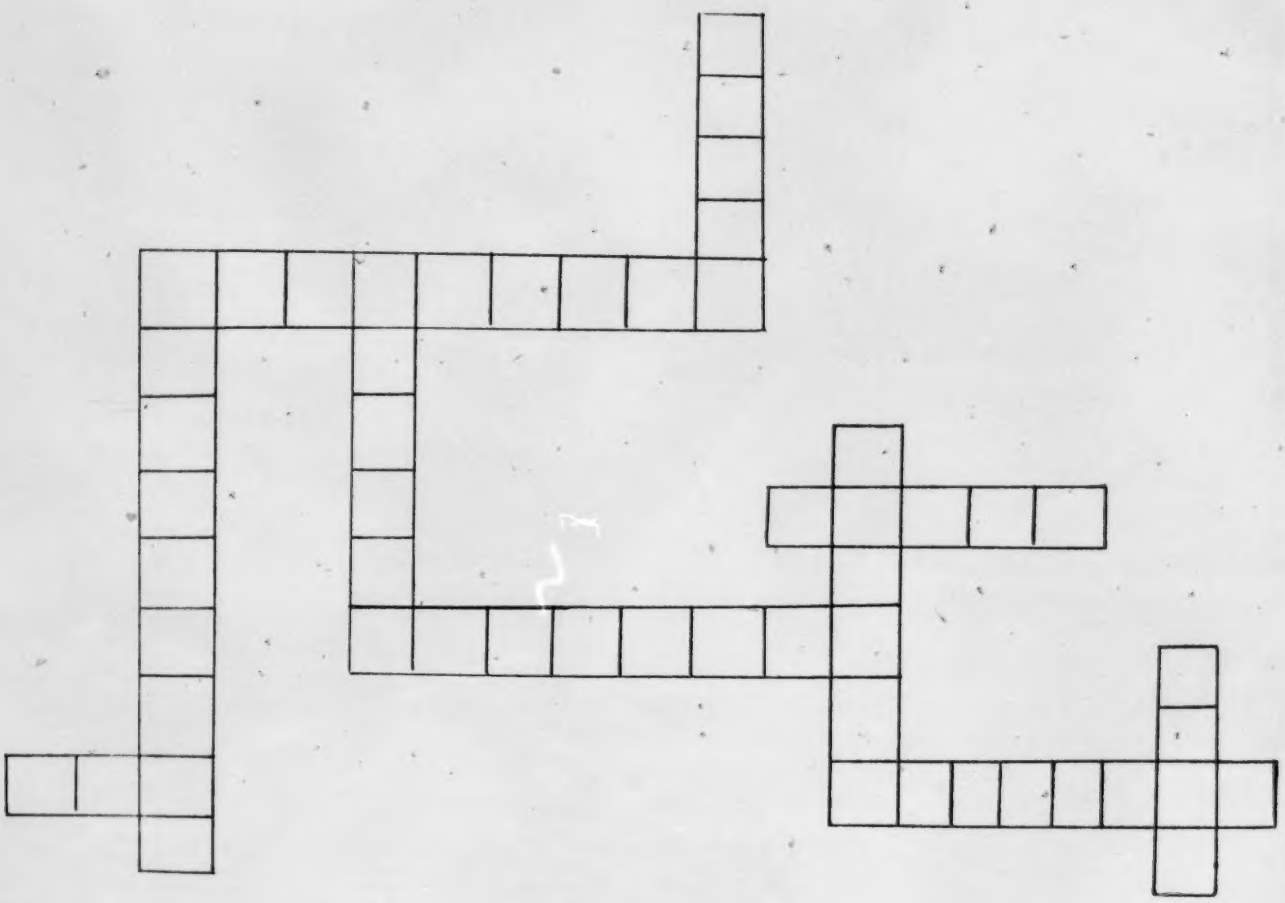
NOW YOU CAN GIVE







NOW YOU CAN GIVE



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II Magazines

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III Tapes, Records, Filmstrips

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Black Heritage series. Imperial International Learning, 1969.

"Image Makers" (Filmstrip), Eye Gate House, Inc., 1969, Jamaica, New York.

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PROSPECTUS: BENJAMIN BANNEKER MODULE

A paucity of the inclusion of minority ethnic group members' contributions to our nation and her development in K-12 curricula has led to the creation of this module. Associated with this paucity of minority contributions has been the complaint of many teachers of an ignorance of these contributions to various facets of this country's history, development, and economy.

The purpose of this module is twofold: (1) to enable K-12 teachers to begin developing an awareness and cognition of the many contributions of members of minority groups; in this particular instance the curriculum area is defined as mathematics and (2) to demonstrate how teaching strategies that recognize these contributions may be developed and utilized as a viable supplement to mono-ethnic and mono-racial curricula.

Prerequisites for Teachers

1. Knowledge of the life and contributions of Benjamin Banneker and/or other minority group individuals who have made significant contributions in the area of mathematics.
2. Can write a performance or behavioral objective at a minimum of two cognitive levels (Bloom's Taxonomy of Educational Objectives).
3. Can write and/or develop convergent and divergent questions within a teaching strategy (lesson plan).
4. Knowledge of the mathematics concept being presented to the students.

THE WORK OF A MASTER SURVEYOR

Grade Level:

This unit is designed to be taught within a middle school grade ranges (6-8) or within the framework of a secondary school math curriculum (9th or 10th grade). The time for teaching this unit may vary, but it is anticipated that the activities could be accomplished within four to eight days. The time period depends upon the approach used by the teacher. A multi-dimensional curriculum approach is utilized throughout the lessons. The activities include a multi-media base as well as utilization of community resources. The activities are designed to be used in various instructional settings; namely, large groups, peer groups of various descriptions, and individuals. The teacher functions as the facilitator of learning.

This unit provides the student with many and varied experiences of working in a coordinate plane. The graphing of solution sets of equations and inequalities involves finding several ordered pairs of numbers that satisfy a given open sentence. Experience has shown that many students need careful instruction in the ideas of this unit if they are to be successful in algebra. It would be a mistake to allow students to work on the coordinate plane with the idea that graphs of solutions sets of equations are always linear. For this reason, some nonlinear graphing is included. Nonlinear is used here to lead to a graph that is a curve rather than a straight-line graph.

Performance Objectives

1. The student will be able to describe at least two of Benjamin Banneker's contributions. The student will exercise his option in the method to describe the above.

2. Given access to multi-media based materials the student will be able to state orally or in a written report the concern of Banneker over the plight of the Black people in this country during colonial times.
3. Given a choice of aerial photographs the students will be able to draw the shape or outline as they appear in the photograph. The student will label on his map by symbols or use of a legend five objects just as they appear in the photograph.
4. Given a set of ordered pairs, the student can plot and label the points on a coordinate plane.
5. a.) Given a list of linear equations containing one variable, the student can graph the solution set for each equation on a coordinate plane. b.) Same as (a) but adapted to inequalities.
6. a.) Given a list of linear equations containing two variables, the student can graph the solution set for each equation on a coordinate plane. b.) Same as (a) but adapted to inequalities.
7. Given pairs of linear equations containing one or more variables, the student can graph each pair on a single coordinate plane and label the point of intersection.
8. Given access to a suitable area the student will be able survey the area and make an accurate map of it. The student will be given his choice of using (1) a natural base line or (2) an artifical base line and he will be able to calculate the offset distances.
9. Given access to materials the student will be able to construct the devices needed for objective eight.

Rationale

Benjamin Banneker was able to predict a solar eclipse based upon his calculations on Aril 14, 1789. His almanac of the 1790's was widely read and yielded a vast amount of information. The city of Washington, D.C. with its streets and major buildings stands today as a monument to Banneker's genius. The mathematical skills possessed by Banneker were developed as a result of self study, determination and curiosity.

Initiating Activities

Varied instructional settings are employed by the teacher. It is assumed the teacher has administered a pre-test or used some form of a diagnostic test to determine which objectives have been accomplished by the students. Therefore, based upon the results, the teacher will designate the objectives each student is to accomplish.

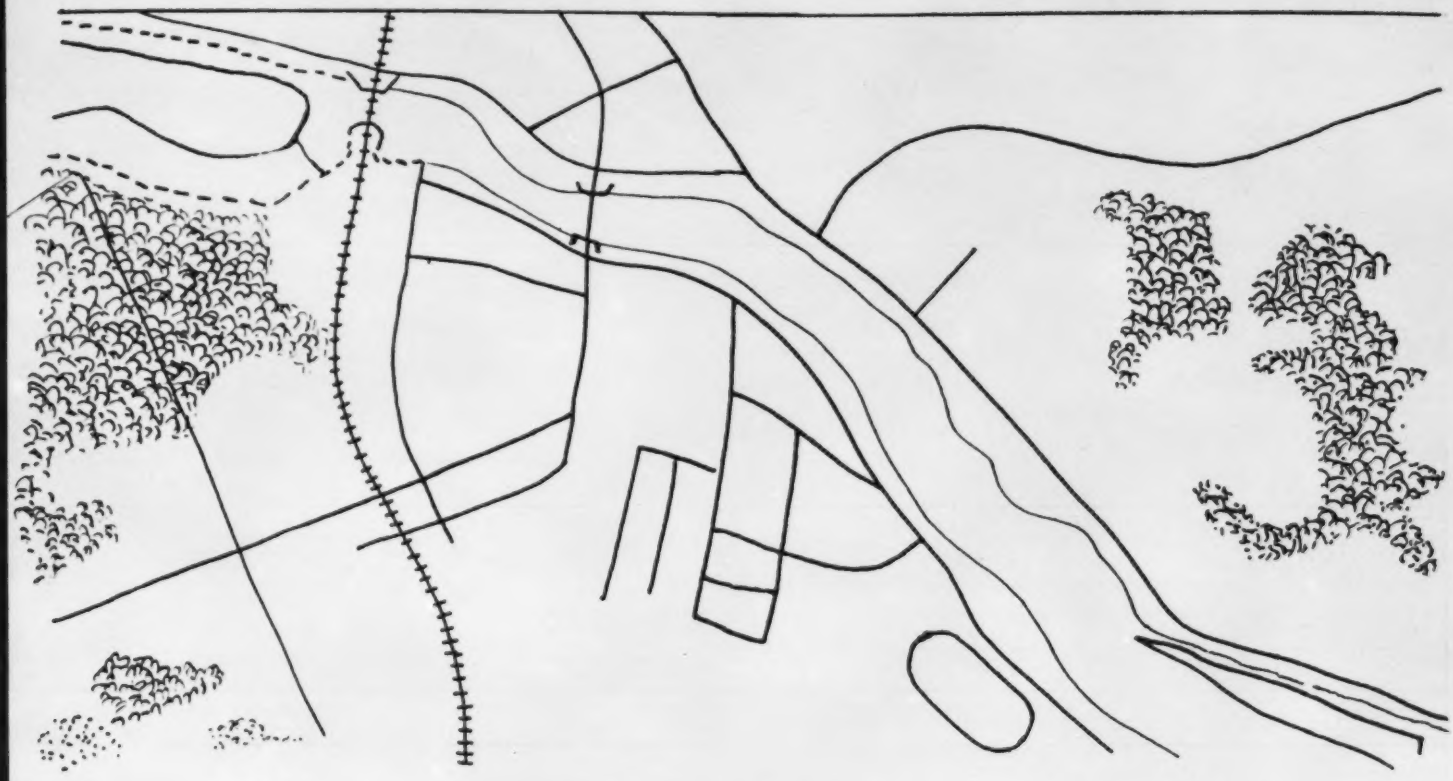
A. Make available reading material on the life of Benjamin Banneker as well as audio visual materials. Consult the bibliography for these materials. Consult the bibliography for these materials. Objective 1 and 2 require the student to know of this man's contributions, his life, and his mathematical skills. The student may pursue these objectives using any or all of the materials available on Benjamin Banneker. As a resource person, the teacher must be available to guide the student in his quest for additional materials.

B. Aerial maps of the surrounding region are to be available in the classroom. Allow time for exploration of these maps. A small group setting may be beneficial for this activity. The teacher may wish to record the directions for this objective (3). The following dialogue may be used:

"A map is a special way of looking at something. Examine the photographs. Many of these photographs were taken from an airplane flying at an altitude of about 8,000 feet, over a mile high! The photographer aimed his camera straight down at the ground. Can you see houses, trees, and streets? Try to pick out rivers, the bridges over the river, a railway track, a canal, and a dam. In which direction does the river flow? Can you find farms, orchards, and woodlots? How can you tell the difference between a field and a wooded area? What other objects can you identify? What is a landmark? Your assignment is to reproduce an outline map of one of the aerial photographs. On a piece of paper, draw the shape or outline of five or more objects as they appear in the photograph. Each shape that you have drawn can be called a symbol. Symbols are used to stand for, or represent, objects. Now look at the picture of a map. How many symbols that you have drawn on your paper can you find on the map? How can you tell if the photograph and the map are of the same place? What can you see in the photograph that you cannot see on the map? What symbols would you use if you wanted to add these objects to your maps? Why is the photograph called an aerial photograph? In which direction are you looking when viewing the map? Imagine that the photographer had pointed his camera at a different slant to the surface of the ground below. Would this aerial photograph be more like a map or more like a picture? What does the word, perpendicular, mean? What words can you find in this activity that tell you that the photographer's camer was held so that it was perpendicular to the surface of the ground? What details in the photograph shown are too small to be seen? Would a car be a landmark? What objects could be more easily identified in the map than in the

picture? Why? What things might be seen on a map that would not be seen from the window of an airplane?

Your map might resemble this illustration.



An extension of this activity could be taped as follows: "If you thought that maps were mostly used by geographers and navigators, you may be surprised to find that geologists, historians, doctors, engineers, and many others use a large variety of special types of maps. Collect as many types of maps as you can by writing to, or visiting, some of the following sources.

Many gasoline stations will sell you road maps for 10 or 15 cents, or give them to you for free. Road maps may be obtained free of charge by writing to the Tourist Information Bureau of your provincial or state

government. Visit an architect's or civil engineer's office and ask politely for some blueprints that will no longer be needed. The school caretaker may allow you to examine the blueprints of the school building. Examine various history books and try to find some maps drawn by early explorers. A librarian may be able to help you find books that contain old maps. Topographical maps can be purchased from various governmental agencies. Perhaps you could borrow a topographical map from the geography department of a nearby high school. Aerial photographs can be procured from the air photo libraries of your government. Try to obtain an aerial photograph of your area. The library may be an excellent source of anatomy books that show maps of the structure of the human, or other animal bodies. Your family doctor may also be able to help you. Some encyclopedias have excellent maps showing the location of bones, nerves, blood vessels, and other body parts. Your classroom will very likely contain one or more atlases. These books usually contain a wide variety of types of maps. Look at as many of these map collections as you can. What other sources of maps can you find? Complete a chart, similar to the one illustrated, to show how many of each type of map you collected or examined. Place a check mark in the appropriate column. If a map shows more than one set of information, you may have to use more than one check mark. Total the number of check marks for each type of map when you are finished.

How many different types of maps did you discover?

Which was the most common type of map in your collection?

How many maps contained more than one set of information?

For which map was it most difficult to decide what type of map it was? Why?

Which type of maps that you examined would you be most likely to use? To whom might a relief type of map be most useful?

What type of map would be most similar to an aerial photograph?

Try to arrange the maps in order from the biggest to the smallest according to the size of the area they represent. Which were maps of small areas? Which ones represented very large areas? Which types showed two-dimensional representations of an area; that is, length and width only? Which types tried to show height or depth as well as length and width? What are some of the things that must be taken into account before deciding what type a particular map is?"

Types of Maps	Number of Each Examined	Total	My Source of Maps
Relief	√ √ √ √	4	Holt's World Atlas
Route			Road Map
Resources			
Temperature			
Rainfall			
Minerals			
Population			
Soils			
Political			
Distances			

C. Banneker constructed the first clock ever built in the United States in 1753. He used only a compass and ruler for measurement, a picture of a clock and a pocket watch for a model, and carved each of the gears by hand.

The teacher may wish to include this contribution in this unit in terms of enrichment. Students could disassemble a clock or other form of time piece in order to gain an understanding of the mathematical skills that are necessary in order to construct a time instrument.

The central idea behind objective 1 and 2 is to furnish the student with information about one man who was a remarkable scientist, astronomer, mathematician, clockmaker, and surveyor.

If possible the teacher may arrange for a surveyor to visit with the class and the surveyor could explain the skills and competencies that are necessary for this job. Slides could be shown illustrating a crew surveying an area.

Maps of Washington, D.C. should be provided in order to illustrate the feat Banneker accomplished from memory. The original plans of L'Enfant are not available today, but Banneker's plans are. Draw attention to the fact L'Enfant is generally credited with this accomplishment and no mention is made of Banneker's work.

Mathematical Activities

Objectives 4, 5a, 5b, 6a, 6b, and 7 are mathematical activities which the teacher can provide from the adopted textbook or other math textbooks. Most textbooks beginning at the 6th grade level and continuing through the first course in Algebra contain activities that would enable the student to accomplish the above named objectives. It is anticipated that a wide range of activities will be needed. The teacher can establish pre-requisites for each objective and administer a pre and post test. A module for each objective could be used in order to facilitate small groups. The time period for these objectives could vary greatly within a classroom.

Culminating Activities

Objectives 8 and 9 are designed for the student to apply his skills and knowledge acquired from objectives 1-7.

The teacher should arrange for students to leave the school building and be free to select the area for surveying and mapping. The teacher can give guidance and some instruction but it is preferred that the students choose their area and form their group.

It is implied the teacher will assist the students in being able to distinguish whether the use of a natural base line or an artificial base line would be most advantageous to the area selected. It is highly probable that some instruction will have to be given when the students begin to calculate offset distances.

A visit to City Hall could produce maps of the general area that could be compared to the maps the students reproduce. Additional activities can be supplied to the students who wish to pursue this topic further.

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IT'S THE REAL MCCOY

Grade Level:

These lessons are designed to be taught in the eighth and ninth grades. The time period is approximately two to three weeks.

Performance Objectives:

1. The student will be able to describe in writing the contributions of Jan Matzeliger, Elijah McCoy, and Granville T. Woods.
2. The student will be able to analyze in writing the effects of these Black men's contributions upon their respective industries and the U. S. economy during the 19th century.
3. Given access to materials that can be utilized to construct models of these men's inventions, each student will select at least one invention and construct a model of it.
4. The student will be able to compare and analyze orally or in writing the social problems (racism, deprived education, emasculated manhood, religion discrimination, and second class citizenship) that these three men faced in the 19th century.

Initiating Activity:

The students will be introduced to this unit by providing them with ample descriptive materials of these men and their contributions. These descriptive materials should consist of the men's biographies, drawings and/or diagrams of their inventions, pictures of their inventions, examples of their 19th century inventions and/or 20th century examples of their inventions.

Questions:

What social problems did these men encounter during their lifehood?

How did each man deal with these social problems?

Compare and contrast their approaches to these social problems.

If these men were alive today would their social problems be the same or different? Why or why not?

Second Activity:

It is suggested that this activity be done in small groups (4 to 6 students). If possible three large tables should be placed at different locations in the room. Each table should be set up with the materials related to the inventions of one of the three men. For example, "The Real McCoy" table setup may include samples of different lubricants--oil, grease, graphite, etc.; lubricating cups from factory equipment, working or nonworking machines, power or hand mowers, engines of toys, car engine parts, refrigerators, mixers and blenders, etc. Note: A visit to a junkyard can be very profitable. The table should also contain machine parts or engine parts that require periodical lubricating by hand. The table should also contain materials that may be used to construct different models for automatic lubrication. Each group of students should be allowed to explore the materials on their table. During this exploration they should be encouraged to make observations and inferences.

Questions:

How are these engines or machines lubricated?

Is the same method of lubrication used for each?

Select one of the engines and discuss how you think Mr. McCoy may have approached the problem of automatic lubrication for it. Following your

discussion construct a model which you think will provide automatic lubrication for the chosen engine or machine.

Third Activity:

After each group has had an opportunity to work through each table set of experiences--"It's The Real McCoy," "The Lasting Shoe Table," and "The Telegraphony Table"--the entire class will be assembled for a discussion of the effects of these men's contributions on the economy during the 19th century.

Questions:

What effects do you think McCoy's automatic lubricating cup had upon the growth of factories during the 19th century? Allow each student to respond.

If McCoy's automatic lubrication for trains had come fifty years later, how may this have effected the U.S. economy in the 1900's and today?

Culminating Activity:

A field trip to a factory, shoe factory or repair shop, machine shops, newspaper companies, light and power company or electrical appliance production company, train station or railroad yard. Then have each student write a report in which they respond to the question: Analyze the effects of these Black men's contributions upon their respective industries and the U.S. economy during the 19th century.

RESOURCE MATERIALS

"It's The Real McCoy"

1. "Industrialization." (SA-2401). Field Enterprises Educational Corp. Merchandise Mart Plaza. Chicago, Illinois 60654. 1965. 12 pp. 25 cents. Guide for teachers to help in preparing a teaching plan on industrialization. Contains illustrations and bibliography. Inter. and jr. hi. levels.

2. "Yesterday--Today--Tomorrow." Western Union. 60 Hudson St. New York, New York 10013. Undated. 6 pp. Free. Illustrated pamphlet discussing the history and recent developments of Western Union.

3. "Electric Utility Industry Booklets." Edison Electric Institute. 750 3rd Ave. New York, New York 11017. Titles include:

   "Power and Progress." Publ. No. 67-54. 1967. 36 pp. 2-9 copies, 60 cents. Definition of electricity and how it is developed and used in serving the nation. Well illustrated.

   "Questions and Answers About the Electric Utility Industry." Publ. No. 68-71. 1968. 39 pp. 25 cents. Complete answers to 37 questions about practical aspects of electricity using charts, maps, and diagrams.

4. Science Materials. Encyclopedia Britannica Educational Corp. Reference Divison. 425 N. Michigan Ave. Chicago, Illinois 60611. 25 cents each. Title:

   "Energy and Machines." 8-page illustrated teaching guide. Outline, concept chart in color, variety of activities, and list of resource articles. Usable at different grade levels.

5. "Negro: The Story of Black Americans--Yesterday and Today." (SA-2679) Field Enterprises Educational Corp. Merchandise Mart Plaza. Chicago, Illinois 60654. 1969. 14 pp. Single copy free to teachers. 2-20 copies, 20 cents each. Reprint from The World Book Encyclopedia. Illustrated.

6. Brown Shoe Company, Public Relations Dept., 8300 Maryland Ave., St. Louis, Mo. 63105. Student kit, "A Study of Shoemaking," includes booklets: "How American Shoes Are Made," "Shoes of Yesterday," "Leather In Our Lives," "The Life and Times of Buster Brown," and "A History of Brown Shoe Company." One kit per classroom. Produces several 16 mm. color films on leather and shoemaking: "Why the Shoe Fits," "Mural in the Making," "Leather in the Making," and "Quality at Your Feet." Available from Swank Motion Pictures, 621 N. Skinker, St. Louis, Mo. 63130. Materials also useful for home economics. (5th-12th Grades)

7. Detroit Diesel Allison Division, General Motors Corp., 13400 W. Outer Dr., Detroit, Mi. 48228. Diesel engines. Booklets: "A Power Primer," "How the Wheels Revolve," "Diesel: The Modern Power," "Electricity and Wheels," and "Fuel Oil and High R.P.M. Engines" (7th Grade-Adult Education.); "Detroit Diesel Power," "There Is a Difference in Diesels," "Engines for Defense Equipment," "The Universal Power," and others (10th Grade-Adult Ed.). Single copies only; request on school letterhead. Request "Detroit Diesel training Aids Catalog" for annotated description of booklets, manuals, wall charts, 16 mm. sound films, and 35 mm. filmstrips.

8. General Electric Company, Lamp Div., Inquiry Bureau, Nela Park, Cleveland, Ohio 44112. Electric light. Wall chart: "Tree of Light," a pictorial history of light source development; single copies to teachers. Booklet: "The Extraordinary Light Bulb," available in classroom quantities. Materials also useful for science (5th-12th Grades)

APPENDIX

PRE-ASSESSMENT ON SCIENCE HISTORY UNIT

Acceptable Responses

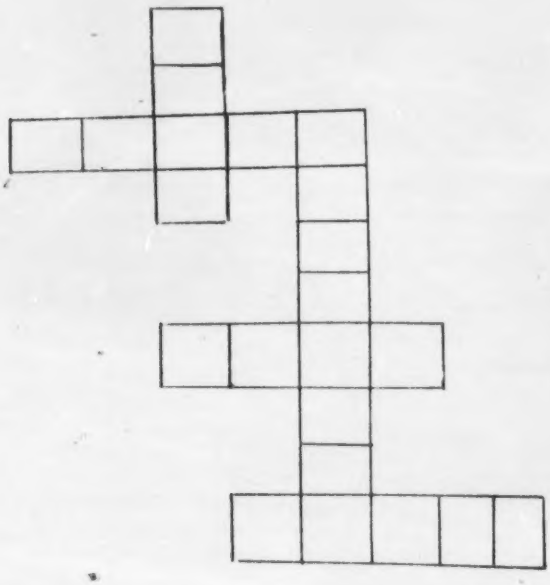
BLACK PIONEERS OF SCIENCE & INVENTION	ACCOMPLISH-MENT(S)	ROLE OF ACCOMPLISHMENT IN THE DEVELOP-MENT OF SCIENTIFIC/ECONOMICAL PROGRESS
1. Garrett A. Morgan	d.	Morgan's invention of the gas mask revolution-ized public safety, especially that of firemen, rescue workers & miners. The concept of gas warfare during WWI could have been disastrous to this country if it had not been for Morgan's gas mask invention. Morgan's traffic signal invention safety & economical value is self-evident.
2. Benjamin Banneker	f.	Banneker is credited with having built the first clock in the U.S. Banneker's interest in astron-omy & mathematics led to his development of an almanac which was widely distributed in the Middle States. Banneker's engineering genius enabled him to reproduce L'Enfant's plans for the design of Washington, D.C. and which stands as a monument to his intellecutal abilities.
3. Norbert Rillieux	c.	Rillieux's invention of the vacuum pan evapora-tor revolutionized the world's sugar industry. This invention made it very economical to produce refined crystal sugar. Consequently sugar products could be produced much cheaper than before. Louis Haber writes: "Public acclaim was widespread. Rillieux had indeed revolu-tionized the sugar industry. A superior sugar product was secured at a greatly reduced cost. His evaporator did not merely replace a manual operation with a mechanical one; it represented a complete change in theory as well as in method (Black Pioneers of Science and Invention). When one recognized that the south's economy was dependent upon the conversion of sugar can to sugar, the significance of Rillieux's invention cannot be over-estimated. As Charles Browne, an outstanding sugar chemist of the United States Dept. of Agriculture, stated, "I have always held that Rillieux's invention is the greatest in the history of American chemical engineering & I know of no other invention that has brought so great a saving to all branches of chemical engineering."

BLACK PIONEERS OF SCIENCE & INVENTION	ACCOMPLISH-MENT(S)	ROLE OF ACCOMPLISHMENT IN THE DEVELOP-MENT OF SCIENTIFIC/ECONOMICAL PROGRESS
4. Lewis Latimer	g.	Lewis Latimer was an electrical genius. He improved the filament in the incandescent lamp. He developed the system for lighting buildings & cities with parallel circuits instead of series circuits.
5. Percy Julian	i.	Julian successfully worked on the soya-bean & led to the development of many inexpensive products which replaced exorbitant expensive chemicals in paint, paper, textile, etc. Dr. Julian's chemistry genius enabled him to develop methods for extracting soybean sterols necessary for the synthetic production of sex hormones at a very low cost. Dr. Julian's most significant contribution was the synthesis of cortisone, thus making it inexpensive and available to arthritis sufferers.
6. Daniel Hale Williams	j.	Williams performed the first heart operation. He founded the Provident Hospital. Dr. Williams pioneered the use of aseptic techniques in surgery. "The world will remember Dr. Williams as a great American surgeon accorded top rank by his contemporary colleagues, white and black; as the founder of Providence Hospital, the first interracial hospital in the United States & the forerunner of a hundred such institutions; as the first surgeon in the world to successfully enter the chest cavity; as the one who introduced the training of Negro nurses and interns in the United States; as a charter member of the American College of Surgeons; and finally, as one of the founders and 1st Vice-President of the National Medical Association. (Black Pioneers of Science and Invention).
7. Granville T. Woods	b.	Woods surpassed most men in the field of electricity in the number of inventions. He invented telegraphony, railway telegraphy, the "third rail," automatic air-brake, & other electrical devices. It is of no small significance that the railroad economical success owes a lot to Mr. Wood's electrical device contributions.

BLACK PIONEERS OF SCIENCE & INVENTION	ACCOMPLISH-MENT(S)	ROLE OF ACCOMPLISHMENT IN THE DEVELOPMENT OF SCIENTIFIC/ECONOMICAL PROGRESS
8. Elijah McCoy	a.	"It's the real McCoy," is still a very familiar statement today. Few people attribute this statement to the ingenuity of a black man's invention of automatic lubrication of machinery used in factories during the industrial revolution. McCoy's lubricating cups were also used on trains, engines.
9. Jan Matzelinger	h.	Jan Earnest Matzelinger's invention of the lasting machine revolutionized the shoe industry. I would dare say that unquestionably the increased availability of shoes was due to their increased production & decreased cost as provided through this black man's genius.

CANDY = SUGAR + A BLACK MAN'S GENIUS

PUZZLE 1



Puzzle Clues (1)

down

1. bubble up and give off steam
2. man who plans and builds machines

across

1. color of refined sugar
2. a source of sugar
3. the color of unrefined sugar

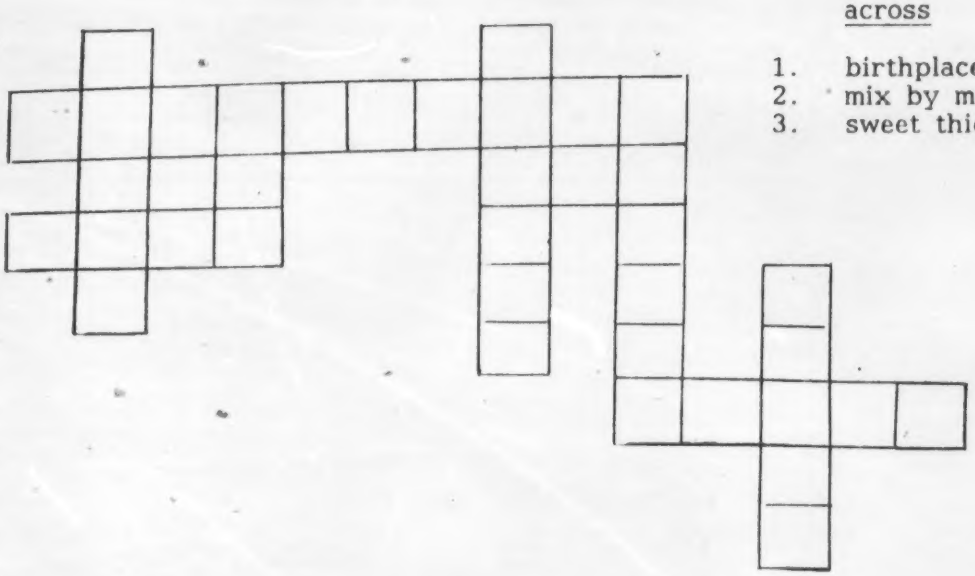
Puzzle clues (2)

down

1. a major source of sugar
2. _____ pan, invention of Rillieux
3. people who stir the syrup-like mixture
4. city where Rillieux is buried

across

1. birthplace of Rillieux
2. mix by moving around with a spoon
3. sweet thick liquid



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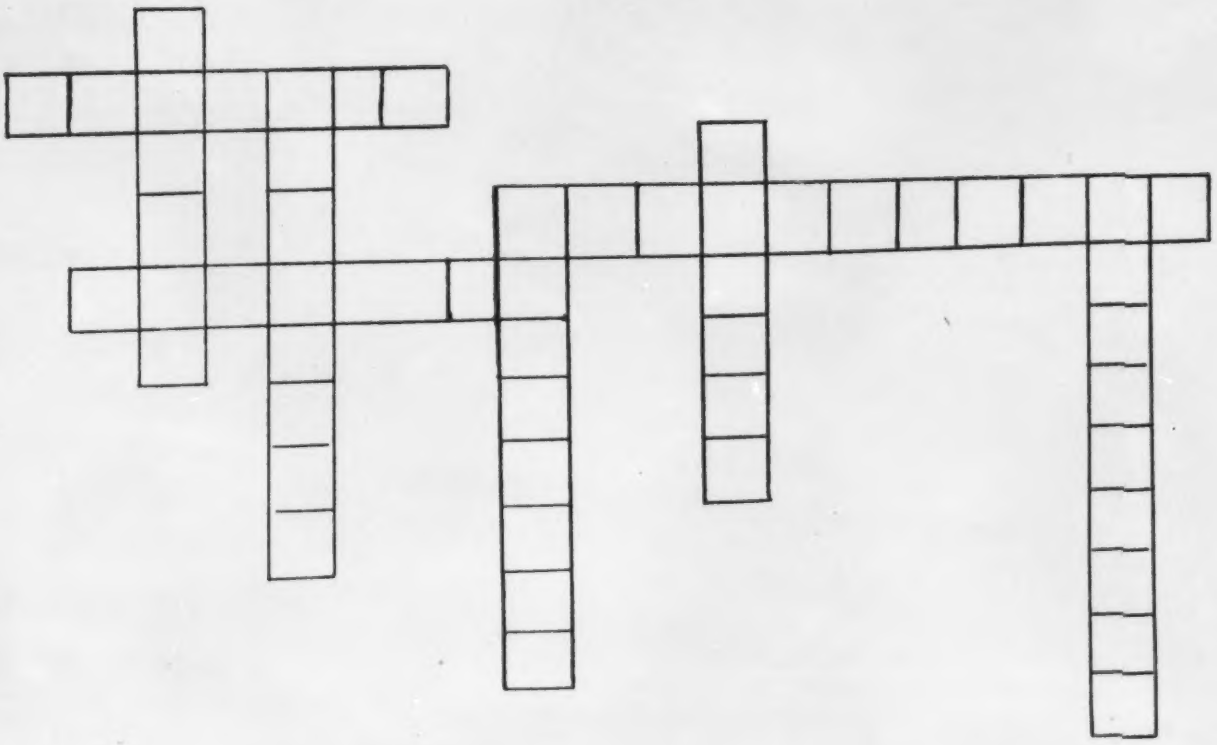


Puzzle Clues

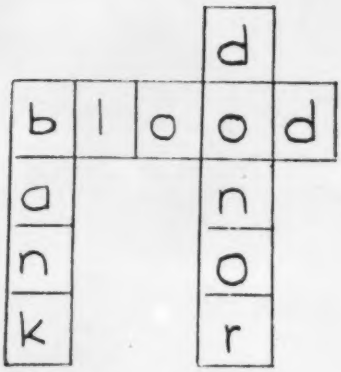
down

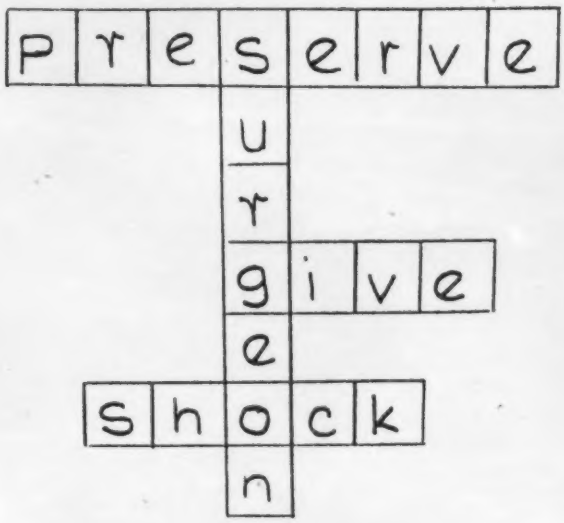
1. to make pure
2. large pot for boiling liquid
3. regular shaped pieces with angles and flat surfaces into which many substances solidify
4. government grant to a person by which he is the only one allowed to make or sell a new invention

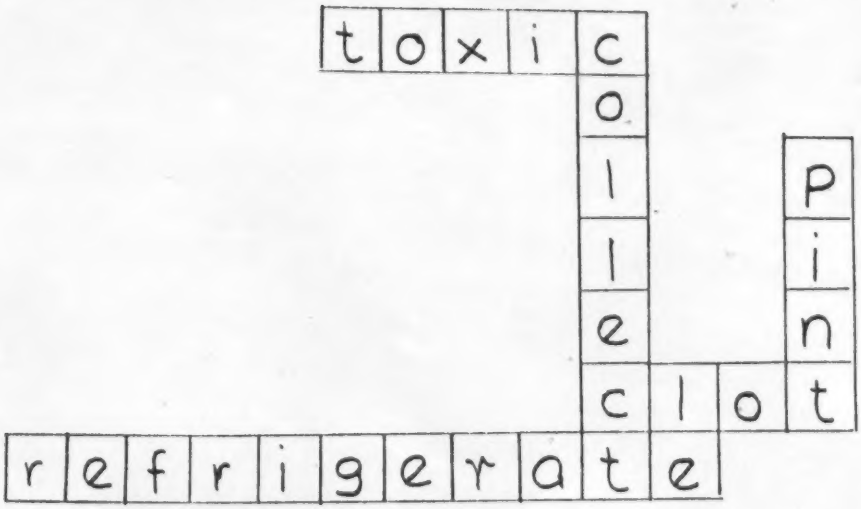
across

1. man not a slave
2. one who invents
3. sugar that has been burned

NOW YOU CAN GIVE







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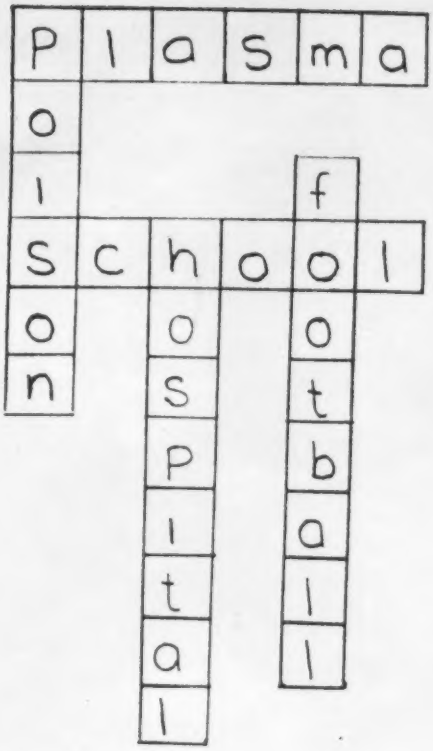

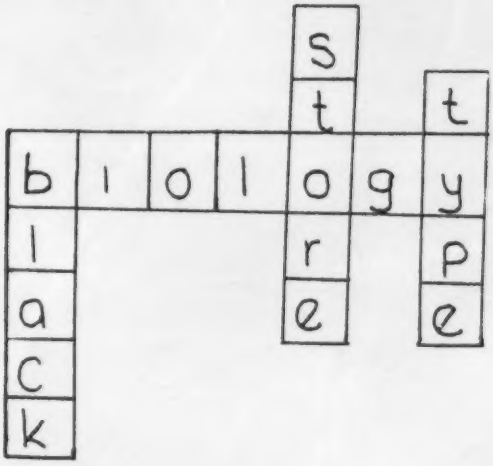

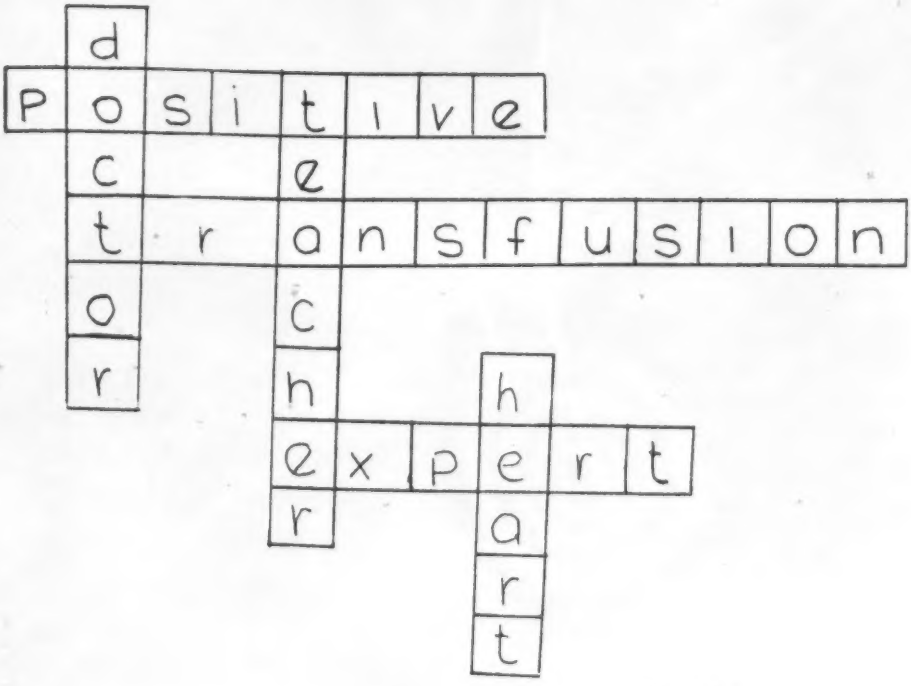

NOW YOU CAN GIVE